

Approved for use through 07/31/2006.  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE  
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PTO/SB/21 (09-04)

2200  
AF

**TRANSMITTAL  
FORM**

(to be used for all correspondence after initial filing)

		Application Number	08/849,746
		Filing Date	September 5, 1997
		First Named Inventor	Loher et al.
		Art Unit	1732
		Examiner Name	Stefan Staicovici
Total Number of Pages in This Submission		Attorney Docket Number	HAH-PT001

**ENCLOSURES (Check all that apply)**

<input type="checkbox"/> Fee Transmittal Form	<input type="checkbox"/> Drawing(s)	<input type="checkbox"/> After Allowance Communication to TC
<input type="checkbox"/> Fee Attached	<input type="checkbox"/> Licensing-related Papers	<input type="checkbox"/> Appeal Communication to Board of Appeals and Interferences
<input type="checkbox"/> Amendment/Reply	<input type="checkbox"/> Petition	<input checked="" type="checkbox"/> Appeal Communication to TC (Appeal Notice, Brief, Reply Brief)
<input type="checkbox"/> After Final	<input type="checkbox"/> Petition to Convert to a Provisional Application	<input type="checkbox"/> Proprietary Information
<input type="checkbox"/> Affidavits/declaration(s)	<input type="checkbox"/> Power of Attorney, Revocation	<input type="checkbox"/> Status Letter
<input type="checkbox"/> Extension of Time Request	<input type="checkbox"/> Change of Correspondence Address	<input type="checkbox"/> Other Enclosure(s) (please identify below):
<input type="checkbox"/> Express Abandonment Request	<input type="checkbox"/> Terminal Disclaimer	
<input type="checkbox"/> Information Disclosure Statement	<input type="checkbox"/> Request for Refund	
	<input type="checkbox"/> CD, Number of CD(s) _____	
	<input type="checkbox"/> Landscape Table on CD	
<input type="checkbox"/> Certified Copy of Priority Document(s)	Remarks	
<input type="checkbox"/> Reply to Missing Parts/ Incomplete Application		
<input type="checkbox"/> <input type="checkbox"/> Reply to Missing Parts under 37 CFR 1.52 or 1.53		

**SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT**

Firm Name	VOLPE AND KOENIG, P.C.		
Signature			
Printed name	Stephen B. Schott		
Date	6/19/2006	Reg. No.	51,294

**CERTIFICATE OF TRANSMISSION/MAILING**

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Mail Stop Appeal Brief-Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature			
Typed or printed name	Stephen B. Schott	Date	6/19/2006

This collection of information is required by 37 CFR 1.5. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

**BEST AVAILABLE COPY**



**PATENT**  
**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In the **PATENT APPLICATION** of:

Loher et al.

**Application No.:** 08/849,746

**Confirmation No.:** 4225

**Filed:** September 5, 1997

For: PROCESS FOR MANUFACTURING  
COMPONENTS MADE OF FIBER-  
REINFORCED THERMO-PLASTIC  
MATERIALS

Group: 1732

Examiner: S. Staicovici

Our File: HAH-PT001

Date: June 19, 2006

**SUBSTITUTE APPEAL BRIEF PURSUANT TO 37 C.F.R. 41.37(c)**

Mail Stop Appeal Brief-Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This Response to the May 17, 2006 Non-Compliant Appeal Brief, reorganizes the original June 6, 2005 Appeal Brief and only adds headings and descriptions to comply with the Notice.

**TABLE OF CONTENTS**

<b>I.</b>	<b>REAL PARTY IN INTEREST .....</b>	<b>- 3 -</b>
<b>II.</b>	<b>RELATED APPEALS AND INTERFERENCES .....</b>	<b>- 3 -</b>
<b>III.</b>	<b>STATUS OF CLAIMS .....</b>	<b>- 3 -</b>
<b>IV.</b>	<b>STATUS OF AMENDMENTS .....</b>	<b>- 3 -</b>
<b>V.</b>	<b>SUMMARY OF THE CLAIMED SUBJECT MATTER .....</b>	<b>- 4 -</b>
<b>VI.</b>	<b>GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL.....</b>	<b>- 5 -</b>
<b>VII.</b>	<b>ARGUMENT .....</b>	<b>- 6 -</b>
<b>VIII.</b>	<b>CLAIMS APPENDIX.....</b>	<b>- 10 -</b>
<b>IX.</b>	<b>EVIDENCE APPENDIX .....</b>	<b>- 15 -</b>
<b>X.</b>	<b>RELATED PROCEEDINGS APPENDIX.....</b>	<b>- 15 -</b>

## **I. Real Party in Interest**

The real party at interest is Sepitec Foundation, an entity organized and existing under the laws of Liechtenstein and having its principal place of business at Kirchstrasse 12, Postfach 818, FL-9490 Vaduz, Fürstentum Liechtenstein.

## **II. Related Appeals and Interferences**

There are no appeals or interferences related to this application that will be directly affected by the Board's decision.

## **III. Status of Claims**

Claims 1-14, 16 and 27-31 are pending and all of these claims are appealed. These claims currently stand rejected from an October 4, 2004 non-Final Office Action, which was issued after two rejections and the filing of a Request for Continued Examination. Claims 15 and 17-26 were previously cancelled. The pending claims are listed in Section VIII, the Claims Appendix.

## **IV. Status of Amendments**

A September 14, 2004 Amendment was the latest amendment entered in this application.

## V. Summary of the Claimed Subject Matter

The application has two independent claims 1 and 2. These claims read as follows:

Claim 1. A process for manufacturing medical components made of fiber-reinforced thermoplastic materials, where a blank formed of fibers and thermoplastic materials is first pre-finished, and said blank is brought into a final form of a component in a negative mold, under pressure, in a hot-forming process, comprising the steps of:

heating the entire blank to a forming temperature with plastic flow consistency in a heating stage located outside the negative mold,

pressing said heated blank into the negative mold using a pressing head that travels at a speed of 2mm/sec to 80 mm/sec, and

shaping the blank in the negative mold by virtue of the entire blank flowing from the heating stage into and filling up the negative mold.

Claim 2. A process for manufacturing medical components which are under stress, made of fiber-reinforced thermoplastic materials, where a blank formed with a fiber proportion of more than 50 % volume and with at least predominant use of endless fibers and said fiber-reinforced thermoplastic material is first pre-finished, and said blank is brought into a final form of a component in a negative mold, under pressure, in a hot-forming process, comprising the steps of:

heating the entire blank to a forming temperature with plastic flow consistency in a heating stage located outside the negative mold,

pressing said heated blank into the negative mold using a pressing head that travels at a speed of 2mm/sec to 80 mm/sec, and

shaping the blank in the negative mold by virtue of the entire blank flowing from the heating stage into and filling up the negative mold.

The application discusses these claim elements in detail. These processes involve forming a blank 7 from fibers and thermoplastic materials that are first pre-finished, and then formed in a negative mold 13, under pressure, in a hot-forming process. See Figure 4, and the accompanying description in the paragraph starting at page 14, line 23. In some embodiments, a fiber proportion of more than 50 % volume is used. See page 14, line 16

The steps of forming the blank are as follows. First, the blank is heated to a forming temperature with plastic flow consistency in a heating stage located outside the negative mold 13. Second, a pressing head presses the heated blank into the negative mold using a pressing head that travels at a speed of 2mm/sec to 80 mm/sec (see page 14, lines 29-32). Finally, the blank is shaped in the negative mold 13 by virtue of the entire blank flowing from the heating stage into and filling up the negative mold.

## **VI. Grounds of Rejection to be Reviewed on Appeal**

The October 4, 2004 Action rejects all of the claims as obvious over different combinations of references. The Action rejects independent claims 1 and 2 as obvious over two sets of references: (1) over EP 0 373 294 in view of U.S. Patent Nos. 4,356,228 to Kobayashi et al. further in view of U.S. Patent No. 4,662,887 to Turner et al.; and (2) JP 02-145327 in view of Kobayashi and further in view of U.S. Patent No. 5,156,588 to Marcune et al.

The issue with respect to claims 1 and 2 is whether the combined prior art suggests all of the claimed elements, but in particular, the step of “pressing said heated blank into the negative mold using a pressing head that travels at a speed of 2mm/sec to 80 mm/sec.”

The Action rejected the remaining dependent claims as obvious over combinations of EP 0 373 294, JP 02-145327, Kobayashi, Turner, Marcune, WO 91/02906 to Gapp et al., U.S. Patent No. 5,223,526 to Gotoh et al., DE 37 39 294, U.S. Patent No. 5,244,747 to Lee, and JP 01-258918.

In claim 7, the issue is whether EP 0 373 294 and JP 02-145327 show that “the shaping of the blank is accomplished by a push-pull extrusion process,” as claimed.

## **VII. Argument**

### **A. The Obviousness Combination**

A combination of references is only proper when there is a suggestion to combine the references and a reasonable expectation of success in combining them. Neither criterion is met here. There is no suggestion within the references themselves for their combination.

The Action combined two groups of references to reject claims 1 and 2. For claim 1, the Action combined EP 0 373 294 in view of U.S. Patent Nos. 4,356,228 to Kobayashi et al. further in view of U.S. Patent No. 4,662,887 to Turner et al. For

claim 2, the Action combined JP 02-145327 in view of Kobayashi and further in view of U.S. Patent No. 5,156,588 to Marcune et al.

The proposed combination of axially-pressure formed screw references (EP 0 373 294 and JP 02-145327) with a process of forming sheet material (Kobayashi) for use in medical devices (Turner and Marcune) is unwarranted. At best, the combination of all of these references is a tenuous weave of unrelated references; at worst, the references were cobbled together only after studying the pending claims, and using these claims as a blueprint for the rejections. In either case, the combination is improper.

EP 0 373 294 discloses processes for forming airplane screws (Col. 1, lines 8-16.), which ignores the sterility and precision required in medical applications. JP 02-145327 describes a nylon resin and braided yarn reinforced screw that is formed in a mold and axially compressed by a punch. Kobayashi, in contrast, discloses several processes for extruding composite sheets for use in “press molding, compression molding, stamping molding,” although Kobayashi admits that “method of molding the preheated sheet is not particularly critical in the present invention.” Col. 5, lines 3-4 and 12-13. The mere inclusion of the medical device patents (Turner and Marcune) does not somehow knit together the disparate aircraft, screw, and sheet references into a proper combination.

Why? Because there is no suggestion to combine the aircraft, sheet-forming and medical arts, especially as one of ordinary skill in the art would recognize the shortcomings of using a sheet-forming process in forming precision medical screws.

Sheet-forming, using an extrusion or press, would not be practical for use in forming a screw, with its fine threads and engagement surface, and thus would never be consulted to look up a suggested injection molding pressing head speed, as has been done in the Action. Action at page 7.

Further, one of ordinary skill in the art would be hard-pressed to look to the process of forming sheet material (Kobayashi) to yield any expectation of success in the art of screw and screw-thread formation. Since there is no suggestion to combine the references and no reasonable expectation of success in combining them, the combination is unwarranted and should be withdrawn, together with the accompanying rejections based thereon.

1. *Claims 1-6, 8-14, 16, and 27-31 are patentable.*

None of the references, alone or in combination, teach “pressing said heated blank into the negative mold using a pressing head that travels at a speed of 2mm/sec to 80 mm/sec.” The Action relies on Kobayashi for this teaching, but Kobayashi teaches “closing molds” at 4 mm/sec, which has nothing whatsoever to do with the claimed “pressing head” of the present invention that is used in an injection molding type process to inject the pre-heated blank that is at a plastic flow consistency into a mold cavity. Kobayashi is directed to the compression molding

art, would not be proper to consult for an injection molded part because compression molding and injection molding are so different.<sup>1</sup>

Therefore, the rejection of claims 1-6, 8-14, 16, and 27-31 is unwarranted.

2. *Claim 7 is patentable.*

The Action rejected claim 7, arguing that EP 0 373 294 and JP 02-145327 teach the claimed push-pull process. Neither reference, in fact, teaches this process. A push-pull process is one in which a thermoplastic is pushed into the mold from a first injection unit, while a second such unit runs in reverse to “pull” the thermoplastic into and through the mold. Then the units both reverse, and the second unit pushes while the first pulls. This yields an extremely uniform part with little or no weld line.<sup>2</sup>

Although the Action argues that EP 0 373 294 and JP 02-145327 show a push-pull process, they do not. EP 0 373 294 shows axially pressing a heated rod into a mold, but it does not teach the “pulling” required in a push-pull process. Similarly JP 02-145327 fails to disclose a “pulling” operation.

Therefore, the rejection of claim 7 is unwarranted.

---

<sup>1</sup> Compare the descriptions of compression and injection molding in the Modern Plastics Encyclopedia, 1994, enclosed.

<sup>2</sup> See, for example, the descriptions of push-pull injection molding enclosed herewith. These are printouts from The Designer’s Guide to Manufacturing, visited at <http://www.designinsite.dk/htmsider/p2007.htm> (last visited May 31, 2005).

## VIII. Claims Appendix

1. (Rejected) A process for manufacturing medical components made of fiber-reinforced thermoplastic materials, where a blank formed of fibers and thermoplastic materials is first pre-finished, and said blank is brought into a final form of a component in a negative mold, under pressure, in a hot-forming process, comprising the steps of:

heating the entire blank to a forming temperature with plastic flow consistency in a heating stage located outside the negative mold,

pressing said heated blank into the negative mold using a pressing head that travels at a speed of 2mm/sec to 80 mm/sec, and

shaping the blank in the negative mold by virtue of the entire blank flowing from the heating stage into and filling up the negative mold.

2. (Rejected) A process for manufacturing medical components which are under stress, made of fiber-reinforced thermoplastic materials, where a blank formed with a fiber proportion of more than 50 volume-% and with at least predominant use of endless fibers and said fiber-reinforced thermoplastic material is first pre-finished, and said blank is brought into a final form of a component in a negative mold, under pressure, in a hot-forming process, comprising the steps of:

heating the entire blank to a forming temperature with plastic flow consistency in a heating stage located outside the negative mold,

pressing said heated blank into the negative mold using a pressing head that travels at a speed of 2mm/sec to 80 mm/sec, and

shaping the blank in the negative mold by virtue of the entire blank flowing from the heating stage into and filling up the negative mold.

3. (Rejected) The process according to Claim 1, wherein the blank is further pre-finished as rod material and is cut to a plurality of lengths required for a final component before the hot-forming process.

4. (Rejected) The process according to Claim 1, further comprising fibers that are endless and have a length that corresponds at least to a length of the blank for a final component.

5. (Rejected) The process according to Claim 1, wherein said blank is composed of layers with different fiber orientation in a lengthwise direction.

6. (Rejected) The process according to Claim 1, wherein the blank is formed from more than one polymer laminate.

7. (Rejected) The process according to Claim 1, wherein the shaping of the blank is accomplished by a push-pull extrusion process.

8. (Rejected) The process according to Claim 1, further comprising the step of:

heating the blank to a forming temperature of 350-450 °C, and then after pressing said blank into the negative mold and shaping thereby,

cooling said shaped blank below the glass transition temperature of the thermoplastic material in a post-pressure phase.

9. (Rejected) The process according to Claim 1, further comprising the step of using carbon or graphite as a release agent for releasing the shaped blank from the negative mold.

10. (Rejected) The process according to Claim 1, wherein the blank is made of PAEK (polyaryl ether ketones) reinforced with carbon fibers.

11. (Rejected) The process according to Claim 1, wherein said blank is formed from endless fibers and at least part of the endless fibers run parallel to an axis of the blank.

12. (Rejected) The process according to Claim 1, wherein at least a portion of the fibers has an orientation from 0 to 90° in the blank.

13. (Rejected) The process according to Claim 1, wherein the fibers have a length of more than 3 mm.
14. (Rejected) The process according to Claim 1, wherein the fibers are surrounded by said thermoplastic material, covering a surface of the blank during said shaping of said blank.
15. (Cancelled)
16. (Rejected) The process according to Claim 1, wherein the components receive an additional surface seal during the hot-forming process.
- 17-26. (Cancelled)
27. (Rejected) The process according to Claim 7, wherein the reciprocating process is performed more than one time.
28. (Rejected) The process of claim 1, wherein the blank is rod-shaped.
29. (Rejected) The process of claim 28, wherein the rod-shaped blank is circular in cross-section.

30. (Rejected) The process of claim 2, wherein the blank is rod-shaped.
31. (Rejected) The process of claim 30, wherein the rod-shaped blank is circular in cross-section.

## **IX. Evidence Appendix**

The undersigned submits two additional pieces of evidence, neither of which have been previously submitted in these proceedings: (1) a short article on compression molding from Modern Plastics; and (2) a website printout discussion push-pull injection molding. The relevance of these has been previously discussed, but in short, these articles describe known techniques and definitions.

## **X. Related Proceedings Appendix**

As previously mentioned in Section II, there are no related proceedings, and thus no appendix is attached.

## **Conclusion**

For the above reasons, Applicants submit that the pending claims are patentable over the prior art. Reconsideration and allowance of the claims is respectfully requested.<sup>3</sup>

Respectfully submitted,

Loher et al.

By   
Stephen B. Schott  
Registration No. 51,294  
(215) 568-6400

Volpe and Koenig, P.C.  
United Plaza, Suite 1600  
30 South 17th Street  
Philadelphia, PA 19103

SBS/tab

Enclosures:

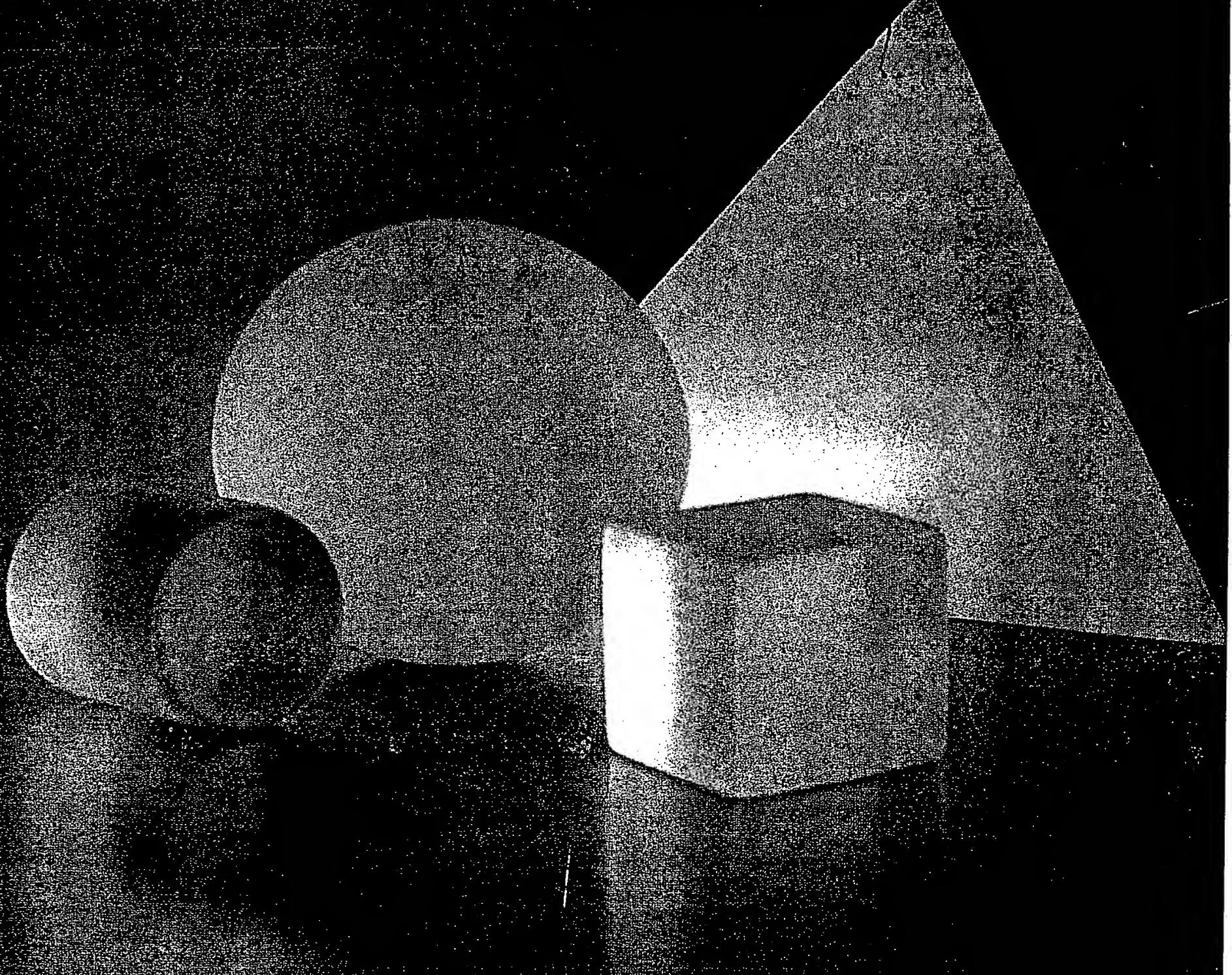
Evidence Appendix  
Modern Plastics Article  
Website printout describing push-pull injection moulding

---

<sup>3</sup> As an aside, Applicant's corresponding European patent EP 0 799 124 B 1 has issued both in Europe and several other countries, over art similar to that cited in this Action.

## **Evidence Appendix**

M O D E R N  
**PLASTICS**



**SPECIAL BUYERS' GUIDE ISSUE &**

**ENCYCLOPEDIA**

Metering and feeding equipment (Supplier descriptions) .....	580
<b>Mold temperature controllers and chillers</b> .....	588
Mold temperature controllers and chillers (Supplier descriptions) .....	589
Pipe and profile, downstream equipment (Supplier descriptions) .....	592
<b>Process monitoring equipment</b> .....	593
Process monitoring equipment (Supplier descriptions) .....	594
Quick-mold-change equipment (Supplier descriptions) .....	597
<b>Raw materials handling and storage</b> .....	598
Raw materials handling and storage (Supplier descriptions) .....	600
Recycling equipment and systems (Supplier descriptions) .....	605
<b>Robots and other parts handling equipment</b> .....	606
Robots and other parts handling (Supplier descriptions) .....	607
<b>Testing equipment and instrumentation</b> .....	610
Testing equipment and instrumentation (Supplier descriptions) .....	612
<b>Total system controls</b> .....	620
Total system controls (Supplier descriptions) .....	621
Web takeoff and handling equipment (Supplier descriptions) .....	624

## Fabricating and finishing **625**

Adhesives (Supplier descriptions) .....	627
<b>Decorating and printing</b> .....	629
Decorating and printing equipment (Supplier descriptions) .....	631
<b>Welding and sealing</b> .....	637
Welding and sealing equipment (Supplier descriptions) .....	641

## North American Buyers' Guide

Classified products index .....	649
Classified products listing .....	651
Ancillary materials and reinforcements .....	665
Auxiliary equipment and systems .....	689
Primary processing machinery .....	682
Resins and compounds .....	651
Semi-finished materials .....	677
Services .....	720
Supplies .....	716
Advertiser literature .....	731
Supplier listing: index of companies and addresses .....	738
Trade name directory .....	785
Custom processor locator .....	810
Advertisers' Index .....	865
Reader service cards .....	869

**Editor**  
Gordon Graff

**Manager, Buyers' Guides**  
Iris N. Topel

**Art Director**  
Bob Barravecchia

**Group art & production**  
Maureen R. Gleason

**Database Editor**  
Steven J. Schultz

**Electronic system support**  
Anna Marie Rutkowski

**Directory Editor, MPI**  
Suzanne Bosshard

**Editorial Assistants**  
Tara A. Collins  
Maria Varvaro

**Electronic page production**  
Cassandra L. Johnson  
Mauro M. Saccà

**Production Editor**  
Deborah David

**Technical Illustrator**  
James B. Stone

**Editor-in-Chief**  
Keith R. Kreisher

**Editorial Director**  
Richard J. Zanetti

**Vice President - Publisher**  
Thomas J. Britton

**Executive Vice President, Publication Services**  
Norbert Schumacher

Officers of McGraw-Hill, Inc.: Joseph L. Dionne, chairman, president and chief executive officer; Robert N. Landes, executive vice senior vice president, Treasury Operations; Robert J. Bahash, executive vice president and chief financial officer; Thomas J. Sullivan, executive vice president, Administration; Elisabeth K. Allison, senior vice president, Planning and Development; Edward J. Heresniak, senior vice president, Information Management; Barbara A. Munder, senior vice president, executive assistant to the chairman.



Please mail all circulation correspondence, subscription orders, and change of address notices to Modern Plastics (ISSN 0026-8275), Fulfillment Mgr., P.O. Box 602, Hightstown, NJ 08520. Postmaster: Send address changes to Modern Plastics, Attention Fulfillment Manager, P.O. Box 481, Hightstown, NJ 08520. Modern

Plastics has no connection with any company of similar name. Modern Plastics printed in U.S.A. Publication Office: 1221 Ave. of the Americas, New York, NY 10020. Modern Plastics issued monthly with an additional issue in November. Second class postage paid at New York, NY and additional mailing offices. Registered for GST as McGraw-Hill, Inc. GST # R123075673. Postage paid at Montreal, P.Q. Canada Post International Publications Mail Product Sales Agreement No. 246530. Available only by paid subscription. Please allow 4 to 8 weeks for shipment. Modern Plastics solicits subscriptions from management, engineering, manufacturing, R&D, scientific and technical, purchasing and marketing men and women involved in the plastics field. Publisher reserves the right to refuse any subscription. Subscription rates for manufacturing, engineering, and R&D companies; also, government and schools (incl. Modern Plastics mid-November issue): in the U.S. and its possessions, 1 yr. \$41.75, 2 yrs. \$62.70, 3 yrs. \$83.50; in Canada, 1 yr. \$CDN 53.00, 2 yrs. \$CDN 80.00, 3 yrs. \$CDN 106.00. Rate for other companies in the U.S. and its possessions \$48.00 per yr.; Canada \$CDN 64.00 per yr. Single copies (except for Encyclopedia issue) \$6.00 each, \$CDN 8.00. To purchase the Encyclopedia, call: 609-426-5129. Price when sold separately is \$57.00. Subscriber service call collect 609-426-7070 in the U.S. except Alaska and Hawaii. The name 'Modern Plastics' is Registered ® U.S. Pat. Off. Copyright © 1992 McGraw-Hill, Inc. All rights reserved.

**PERMISSIONS:** Where necessary, permission is granted by the copyright owner for the libraries and others registered with the Copyright Clearance Center (CCC) to photocopy any page herein for the flat fee of \$5.00 per copy of the page. Payment should be sent directly to the CCC, 27 Congress St., Salem, MA 01970. Copying done for other than personal or internal reference use without the express permission of McGraw-Hill is prohibited. Requests for special permission or bulk orders should be addressed to Modern Plastics Reprint Dept., 1221 Ave. of the Americas, New York, NY 10020. ISSN 0026-8275 \$5.00  
MOPLAY (69) II 1-846

# COMPRESSION MOLDING

## Low equipment costs and consistency of part sizes are outstanding features

Compression molding dates back hundreds of years to the period when it was used to form objects from amber. The same basic process is used today to produce parts from plastics and elastomers.

Compression molding applies pressure to a material placed inside a heated mold for a specified curing period. Although the procedure is slow—cycle times range from under one minute to 20 min. and more—it's simplicity minimizes tooling costs, nearly eliminates material waste, and reduces secondary finishing, and mold wear.

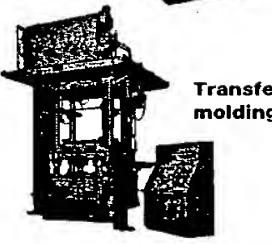
The machinery for compression molding is considerably less expensive than injection molding presses. In addition, compression-molded parts can be fashioned with minimal or zero internal stresses. Consistency of part size is good, and the absence of gate and flow marks in finished products reduces finishing costs.

**By Keith A. Larson**, Sales Manager, Wabash Metal Products, 1569 Morris St., Wabash, IN 46992.

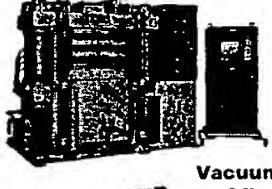
# Wabash



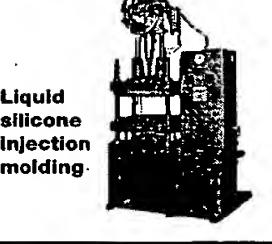
Compression molding



Transfer molding



Vacuum molding



Liquid silicone injection molding

## Molding Presses

Consult Wabash for dependable, high performance hydraulic presses for your production requirements. Select from our wide range of models, capacities, heating systems and state-of-the-art control options.

**Compression molding presses** 15 to 1200 tons, using programmable logic controls for precision and repeatability. Vacuum chamber and high-temperature composite models available.

**Transfer molding presses** from 10 to 500 tons clamp pressure, 3 to 125 tons transfer pressure.

**Liquid silicone injection molding presses** 15-200 ton and  $\frac{1}{4}$  to 19 oz shot capacity.

**Die cutting, trim and custom presses, also available.**

**Carver Laboratory Presses and accessories**

**WABASH MPI**  
P.O. Box 298  
Wabash, Indiana 46992-0298  
Phone 219-563-1184  
FAX 219-563-1396

Circle 79 for Reader Service

Compression molding is most cost-effective when used for short-run parts requiring close tolerances, high impact strength, and low mold shrinkage. Conversely, it is a poor selection for parts with heavy wall sections requiring long cure times, parts with long through-holes, or any soft, large runs. Typical compression-molded parts include gaskets, seals, elastomeric bushings, automotive exterior panels, aircraft fairings, control surfaces, and interiors.

Old as the process may be, new applications continue to evolve for compression molding. For example, in the dental and medical fields, compression-molded orthodontic retainers and pacemaker casings are proliferating because of the low tool costs. Injection molding tools to produce the same part would cost as much as eight times more.

Gaskets and seals are examples of products that were originally compression molded and were later made by injection molding to take advantage of the faster cycle times. However, the quality level required for these parts has been harder to maintain via injection molding, and many manufacturers are now switching back to compression molding.

Like the process, compression-molding machinery is relatively simple. Most compression presses consist of two platens that close together, applying heat and pressure to the material inside.

Mold temperatures typically run between 300 and 400° F., but can go as high as 1200° F. The molds are heated by electric strip heaters, electrical cartridges, steam, or hot-oil systems.

The use of compression molding has expanded tremendously in recent years due to the development of new materials, reinforced plastics in particular. Molding reinforced plastics requires two matched dies usually made of aluminum, plastic, or steel. These lightweight materials are inexpensive to make and are generally used on short runs.

Though some thermoplastics can be compression-molded, the vast majority of materials used are thermosets such as phenolic, urea, melamine, DAP, epoxy or polyester in precombined composites such as BMC (bulk molding compounds), SMC (sheet molding compounds), or TMC (thick molding compounds).

BMC is among the oldest molding systems. A combination of fillers—wood flour, minerals, and cellulose—is mixed with resin and then placed in a mold at 300 to 400° F. and compressed into parts at about 500 p.s.i. Typical applications include washtubs, trays, equipment housings, and electrical components. SMC uses a combination of pre-impregnated resin fillers, catalysts, and reinforcements, cut into part-size sheets or charges, placed in hot molds (usually 300 to 400° F.), and then molded at 1000 to 2000 p.s.i. Typical products include automotive body panels, bathtubs, septic tanks, and outdoor electrical components.

Another relatively new improvement has been the addition of various forms of automation to the process. Further advances in machine and control technology will continue to make the compression molding process more efficient.

a—Length  
b—L = long  
c—A = auto

# INJECTION MOLDING

## Wide array of designs and capabilities make equipment choices complex

The injection molding of thermoplastics is a process in which plastic is melted and then forced into a mold cavity. Once in the mold, the plastic is cooled to a shape reflecting the cavity. The resulting form is usually a finished part needing no other work before assembly or use as a finished product. Details, such as bosses, ribs, designs, and screw threads can be incorporated during the one-step process.

### An injection unit and a clamp are the basic elements of all units

Injection molding machines feature two basic components: an injection unit to melt and transfer the plastic into the mold, and a clamp unit to open and close the mold.

The injection unit melts the plastic and then injects it into the mold with controlled pressure and rate. Two basic injection unit designs are used today: the screw preplasticator or two-stage unit, and the reciprocating screw.

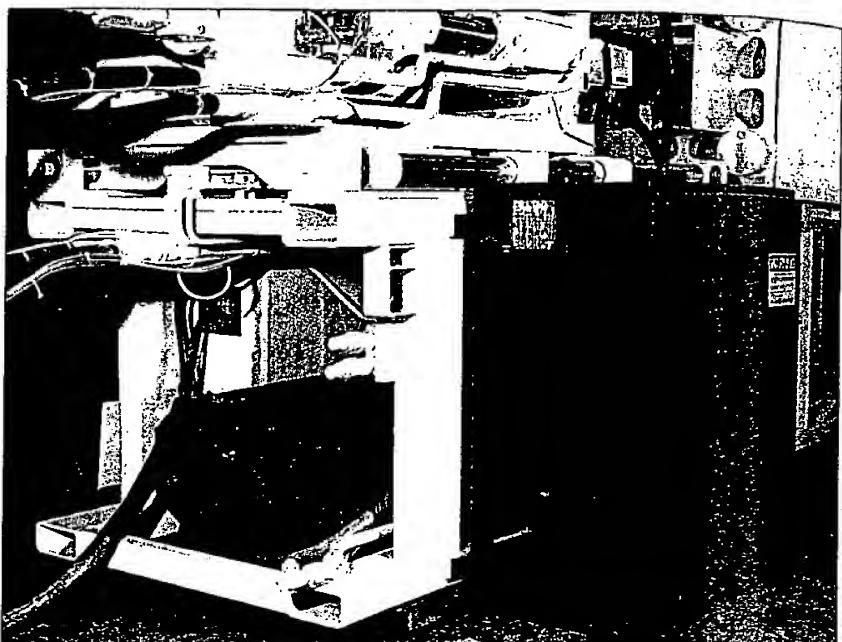
A screw preplasticator uses a plasticating screw (first stage) to feed melted resin into a chamber (second stage). A plunger then forces the plastic melt into the mold. Advantages of the screw-preplasticator are consistent melt quality, high pressures, fast rates, and accurate shot control—benefits useful for clarity, thin-walled parts, and high production rates. Disadvantages include uneven residence time, higher equipment costs, and more maintenance.

The reciprocating screw injection unit, the far more common type, melts and injects the plastic without a plunger. Powdered or pelletized resin is melted in the machine's barrel and transferred to the nozzle end of the machine by a rotating screw. The accumulation of melted plastic at the screw tip forces the screw towards the rear of the machine until enough material is collected for a shot. The screw then is driven forward forcing the melt into the mold.

In reciprocating screw machines, a screw-tip non-return valve is used to prevent material from flowing back along the screw. In recent years, screw-tip non-return valves have been enhanced for a higher degree of part repeatability.

The advantages of reciprocating screw units include reduced residence time, self-cleaning screws, as well as accurate and responsive injection control. These advantages are key to processing heat-sensitive materials, or when making color or resin changes. In addition, reciprocating screws offer repeatable part-to-part consistency and the capability to produce increasingly complex parts with faster cycle times. In addition, closed-loop servovalve control of injection screw velocity and pressure provides repeatable plastic flow into the mold, further improving part-to-part quality. Fast-response servovalve systems also improve processing of parts with complex geometries.

Important factors in plastics processing include tempera-



**Variable-speed brushless d.c. motors can provide energy savings in hydraulic injection units. (Photo, Cincinnati Milacron)**

ture and pressure, consistency, color dispersion, and density of the melt. In both types of machines, the polymer is melted by a combination of heated barrels and the shearing action of a rotating screw. Resins, additives, colorants, and fillers are mixed between screw flights and barrel. General purpose screws can process a wide variety of plastic materials. However, special screw designs can optimize the melting and mixing of distinct classes of plastics resulting in improved melt quality, reduced melt temperatures, faster cycle times, and higher production rates.

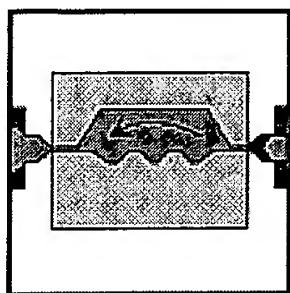
### Toggle, hydraulic and hydromechanical clamp designs have specific functions

Clamp designs in use today include toggle, hydraulic, and hydromechanical types. Toggle clamps are popular on small-tonnage machines because they are less expensive to manufacture. Features include high mechanical advantage at lockup, inherent built-in clamp slow down, slow mold breakaway speed, and rapid clamp operation. A hydraulic cylinder moves the toggle's crosshead forward, extending the toggle links and moving the platen forward. As the clamp closes, the mechanical advantage is low, resulting in rapid platen movement. As the platen approaches the mold-close position, the toggle links change from a high speed/low mechanical advantage to low-speed and high mechanical advantage.

Low speed is critical for mold protection, while high mechanical advantage is needed to build tonnage. Once the linkage is fully extended locking the mold closed, hydraulic pressure is not needed to hold tonnage. Since the toggle linkage must be at full stroke to achieve tonnage, adjusting the clamp to different mold heights is accomplished by

**By Rick Weismantel**, Injection Product Specialist, Cincinnati Milacron, 4165 Half Acre Rd., Batavia, OH 45103

## Process *Push-pull injection moulding*



Suitable for achieving long thin parts with high stiffness in the longitudinal direction. The molecular structure of the parts is very uniform and internal welding lines are reduced.

It is a relatively new variant of injection moulding which improves strength. Unlike injection moulding, two injection units are used for injection of plastic. While one unit is pushing plastic into the mould, the other one is pulling.

First the cavity is filled by the first unit, then pressure and new molten plastic is injected from the second unit to keep the material in motion while it cools down. The process is then reversed.

Danish Name **Push-pull sprøjtestøbning**

Category **Mass conserving processes, Shaping plastics**

Materials **HDPE PA ABS PC PE PP**

Typical products **Window frame for airplane**

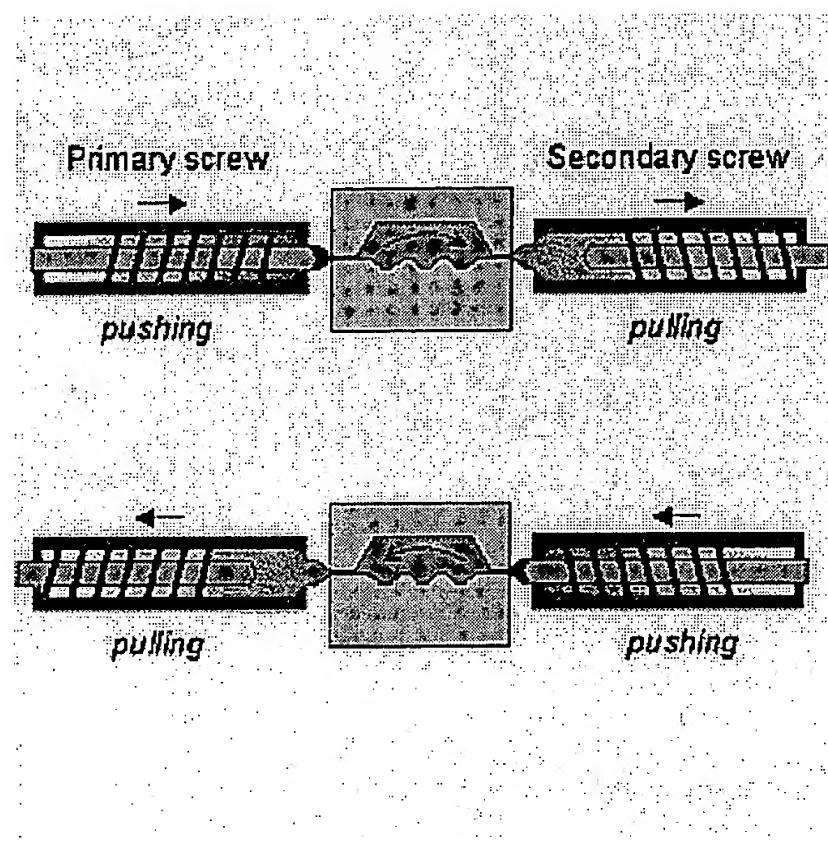
Competing processes **Injection moulding  
Air injection moulding  
Extrusion  
Pultrusion**

Additional info **Possible to achieve good dimensional accuracy and surface finish.**

Photo **Thomas Nissen (Computer graphics)**

Copyright **© 1996-2004 Torben Lenau  
This page is part of Design inSite**

**Disclaimer**



Push-pull injection moulding

[Return to process description](#)

**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

**BLACK BORDERS**

**IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**

**FADED TEXT OR DRAWING**

**BLURRED OR ILLEGIBLE TEXT OR DRAWING**

**SKEWED/SLANTED IMAGES**

**COLOR OR BLACK AND WHITE PHOTOGRAPHS**

**GRAY SCALE DOCUMENTS**

**LINES OR MARKS ON ORIGINAL DOCUMENT**

**REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**

**OTHER:** \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**